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(54) Stain-resistant coated cookware.

(57) Heat-stable coatings on cookware can be made stain-resistant by including a pigmented brown intermediate layer and a clear topcoat layer containing mica or coated mica platelets for sparkle. Such coatings are particularly suitable for electrical cookware.

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TITLE

STAIN-RESISTANT COATED COOKWARE

BACKGROUND OF THE INVENTION

This invention relates to coated cookware
5 having a heat-stable multi-layer nonstick coating.

In modern cookware coatings, it has been
found desirable to provide a sparkling appearance.
However, sooner or later, food stains appear in most
cookware coatings. These stains generally have a brown
10 color and are formed by pyrolysis of particles of food,
oil or other materials which penetrate into the more-
or-less porous outer layers of the coating. This
phenomenon occurs with most types of cookware coating,
including coatings based on polytetrafluoroethylene
15 (PTFE).

The problem of staining becomes more acute
when the temperature profile across the face of the
cooking surface is not uniform. This occurs particu-
larly in cookware heated by an electrical resistance
20 element in the shape of a pattern imbedded in or
against the back of the cookware, i.e., the surface
opposite that on which the coating system is applied.
This staining phenomenon takes the form of a brown
line following the pattern of the heating element.

25 It would be desirable to be able to coat
electric cookware in such a way that no conspicuous
stained pattern develops during use of the cookware.

SUMMARY OF THE INVENTION

This invention provides a cookware article
30 comprising a substrate coated with a heat-stable coating
system having three layers, each layer comprising a
polymer stable at temperatures above 300°C, said layers
including

a primer layer in direct contact with the substrate
35 and which adheres the coating system to the
substrate,

an intermediate layer in contact with the primer layer and containing pigments which mask the brown color of food stains that develop in the coating system during cooking, and
5 a light-transmitting topcoat layer in contact with the intermediate layer and containing mica or mica platelets coated with pigment, giving a sparkling appearance to the coating system.

DETAILED DESCRIPTION OF THE INVENTION

10 It has been found that food stains do not appear conspicuously on cookware coatings, even on cookware heated with a circular electrical heating element on the back, if a three-layer coating is used including a primer, an intermediate layer with enough
15 pigment of an appropriate color to mask the brown color of food stains that develop in the coating, and a light-transmitting top layer containing mica or mica platelets coated with pigment to give a sparkling appearance. Dark brown or black pigments in the intermediate layer
20 are desirable. The present invention draws on technology expressed in other U.S. Patents, including

4,123,401 - Berghmans and Vary (October 31, 1978) directed to coating compositions containing fluoropolymer, mica, decomposable polymer, and a
25 liquid carrier, particularly suited for use as topcoats;

4,049,863 - Vassiliou (1977) directed to primers containing fluoropolymer, colloidal silica, the salt of a polyamic acid, and a coalescing
30 agent, mica, and a liquid carrier;

4,087,394 - Concannon (May 2, 1978) directed to aqueous coating compositions of fluorocarbons and a second film-forming material which can be the salt of a polyamic acid;

35 4,143,204 - Fang (March 6, 1979) directed to coated articles in which the coating comprises

a copolymer of tetrafluoroethylene and hexafluoro-propylene along with an auxiliary film-forming material;

and the following five patents which are concerned with heat-stable coatings containing oxidation
5 catalysts and/or antioxidants:

4,054,704 - Vassiliou (1977),
4,054,705 - Vassiliou (1977),
4,064,303 - Vassiliou (1977),
4,120,608 - Vassiliou (October 17, 1978), and
10 4,122,226 - Vassiliou (October 24, 1978);
and 4,180,609 - Vassiliou (December 25, 1979) is
directed to coated articles having a multi-layer coating
with fluorocarbon and mica in a basecoat and a topcoat,
and with a defined relationship between the concentra-
15 tion of mica in the basecoat and that in the topcoat.

The above-mentioned patents and application are incorporated herein by reference.

Preferably by using techniques of the above-identified patents, cookware is coated with a primer
20 layer, an intermediate layer and a topcoat layer which have the defined relationships to obtain the advantages of the invention.

The following example teaches a preferred embodiment of the invention. Parts, percentages and
25 proportions herein are by weight except where indicated otherwise.

The following coating compositions were used to make the respective coating layers in accordance with the teachings of Example 2 of U.S. Patent 4,049,863
30 for the primer layer and Example 4 of 4,123,401 and Example 1 of 4,180,609 for the intermediate and topcoat layers, respectively.

Briefly, the procedure involved gritblasting an aluminum substrate, allowing the primer to air dry,
35 then spraying on the intermediate and topcoat layers, wet-on-wet, followed by a bake at

425°C for 5 minutes. The resulting coatings were a dark chocolate brown with a sparkling appearance, and they did not show food stain after extensive cooking when the substrate was an electric grill with a patterned electrical resistance heating element embedded in the aluminum.

TABLE I
PRIMER COATING COMPOSITION

	<u>%</u>
10 PTFE Solids (60% solids in water, Du Pont T30)	11.16
Ludox® AM Colloidal Silica Solids (Du Pont)	0.96
Amide-Imide Resin (Polyamide acid of Example 1A of U.S. Patent 4,049,863)	4.93
Octyl Phenol Polyether Alcohol	0.67
15 Deionized Water	67.76
Furfuryl Alcohol	3.60
Diethyl Ethanolamine	0.65
Triethyl Amine	1.31
N-Methyl Pyrrolidone	2.46
20 Cobalt Aluminate Pigment	5.88
Red Iron Oxide Pigment	0.59
Afflair® Pigment (Du Pont) TiO ₂ Coated Mica	<u>0.05</u>
	100.00

TABLE II
INTERMEDIATE COATING COMPOSITION

25	PTFE Solids (60% solids in water, Du Pont T30)	42.39
	Phosphoric Acid (100%)	0.08
	Sodium Lauryl Sulfate	0.03
	Sodium Polynaphthalene Sulfonate	0.01
30	Acrylic Latex Solids (methyl methacrylate/ethyl acrylate/methacrylic acid - 39/57/4 terpolymer dispersion (40% in water) 0.2 micron average particle size)	5.04
	Deionized Water	39.19
35	Octyl Phenol Polyether Alcohol	2.54

TABLE II (cont.)

	<u>%</u>
Triethanolamine	2.82
Oleic Acid	1.14
5 Toluene	4.37
Butyl Carbitol	1.49
Red Iron Oxide Pigment	0.28
Channel Black	0.10
Afflair® Pigment (Du Pont) TiO ₂ Coated Mica	0.43
10 Aluminosilicate Pigment	<u>0.05</u>
	100.00

TABLE IIITOPCOAT COATING COMPOSITION

	PTFE Solids (60% solids in water, Du Pont T30)	43.05
15	Sodium Lauryl Sulfate	0.03
	Acrylic Latex Solids (as in Table II)	4.81
	Deionized Water	42.93
	Triton® X-100	2.58
20	Triethanolamine	1.59
	Oleic Acid	0.75
	Toluene	2.85
	Butyl Carbitol	0.98
	Afflair® Pigment (Du Pont) TiO ₂ Coated Mica	<u>0.43</u>
25		100.00

Instead of the red iron oxide - carbon black combination of Table III, one can use equivalent amounts of burnt umber, having an approximate composition shown in Table IV.

TABLE IVCOMPOSITION OF BURNT UMBER

		<u>%</u>
	Fe ₂ O ₃	40-73
	SiO ₂	10-20
35	Al ₂ O ₃	10-20
	MnO ₂	4-19

6

TABLE IV (cont.)

	<u>%</u>
H ₂ O sol. salts	0.4
Pb	0.02
As	0.03
Mg	0.0075

I CLAIM:

1. A cookware article comprising a substrate coated with a heat-stable coating system comprising three layers, each layer containing a polymer stable
5 at temperatures above 300°C, characterized in that said layers include
 - a primer layer in direct contact with the substrate and which adheres the coating system to the substrate,
 - 10 an intermediate layer in contact with the primer layer and containing pigments which mask the brown color of food stains that develop in the coating system during cooking, and
 - 15 a light-transmitting topcoat layer in contact with the intermediate layer and containing mica or mica platelets coated with pigment, giving a sparklin appearance to the coating system.
2. The article of claim 1 in which the heat-stable polymer is a silicone, polysulfide, poly-
20 merized parahydroxy-benzoic acid, a polysulfone, a polyimide, a polyamide, a salt of a polyamic acid, a polysulfonate, a polysulfonamide, a fluorocarbon polymer, or a mixture of two or more of the above, and said heat-stable polymers are the same or in any
25 combination in the three layers of the coating.
3. The article of claim 1 in which the intermediate layer includes red iron oxide pigment, carbon black, and an antioxidant.
4. The article of claim 3 in which the
30 antioxidant is phosphoric acid.
5. The article of claim 1 in which the intermediate layer includes black iron oxide pigment.

6. The article of claim 1 in which the intermediate layer includes burnt umber.

7. The article of claim 1 in which the topcoat contains an antioxidant.

5 8. The coated article of claim 7 in which the topcoat contains

(a) about 80-99.8%, by weight of the total of
(a) and (b), of a particulate polymer
polymerized or copolymerized from monomers
10 selected from one or more monoethylenically
unsaturated hydrocarbon monomers and
hydrocarbon ether monomers, said monomers
being completely substituted with fluorine
atoms or a combination of fluorine atoms and
15 chlorine atoms, and

(b) about 0.2-20%, by weight of the total of (a)
and (b), of mica particles, mica particles
coated with pigment, or metal flake;
the total of (a) and (b) equaling 100%.

20 9. The article of claim 8 in which the topcoat includes polytetrafluoroethylene or a copolymer of tetrafluoroethylene and hexafluoropropylene

10. The article of claim 1 containing an
electrical resistance heat source in the form of a dis-
25 crete pattern on the opposite side of the substrate from
the coating system.

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EUROPEAN SEARCH REPORT

Application number

EP 80 10 3808

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<p>US - A - 4 177 320 (YOSHIMURA, T. et al.)</p> <p>* Claims 1,2,5,7; column 1, lines 6-12; column 5, lines 27-35 *</p> <p>--</p> <p>US - A - 3 241 545 (REINERT, R.L. FLISS, C.T.)</p> <p>* Claim 1; column 1, line 12; column 7, lines 9-38 *</p> <p>--</p> <p>EP - A - 0 003 760 (E.I. DU PONT DE NEMOURS AND COMP.)</p> <p>* Abstract ; page 2, lines 27-30; page 3, lines 5-14; page 6, example, lines 33-34 *</p> <p>--</p> <p>DA US - A - 4 180 609 (VASSILIOU, E)</p> <p>DA US - A - 4 123 401 (BERGHMANS, S.M.L. - VARY, E.M.)</p> <p>DA US - A - 4 143 204 (FANG, J.C.)</p> <p>A US - A - 4 031 286 (SEYMUS, H.E.)</p> <p>A US - A - 4 118 537 (VARY, E.M. - VASSILION, E.)</p> <p>----</p>	<p>1-4, 8,9</p> <p>1,2,3 5,8,9</p> <p>1</p>	<p>B 05 D 5/06 5/08 A 47 J 36/02</p> <p>TECHNICAL FIELDS SEARCHED (Int. Cl.)</p> <p>A 47 J 36/02 B 05 D 5/06 5/08 7/16 7/24 7/26 C 09 D 3/00 C 08 L 27/18 C 08 L 27/12</p> <p>CATEGORY OF CITED DOCUMENTS</p> <p>X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons</p> <p>A: member of the same patent family, corresponding document</p>
<p><input checked="" type="checkbox"/> The present search report has been drawn up for all claims</p>			
Place of search The Hague		Date of completion of the search 14-10-1980	Examiner JECCHINI